THESIS ABSTRACT

Research leading to this thesis aims to assess the policy relevant mitigation potential of Indian forests as well as aims to assess the impact of climate change on carbon stocks, vegetation boundary shifts, Net Primary Productivity (NPP) and the mitigation potential of Indian forests. To project the impact of climate change we chose a dynamic global vegetation model 'Integrated Biosphere Simulator' (IBIS V.2.6b4). We selected A2 and B2 scenarios for projecting the impacts. Mitigation potential was assessed using the 'Generalized Comprehensive Mitigation Assessment Process' (GCOMAP) model.

We assess the mitigation potential of Indian forests in the light of India's long-term policy objective of bringing 33% of its total geographical area under forest cover. We analyzed the mitigation potential of this policy objective under two scenarios: the first comprising of rapid afforestation scenario with the target to achieving the goal by 2020 and the second a moderate afforestation scenario in which this goal is achieved by 2030. We estimate that afforestation could offset about 9% of India's average national emissions over the 2010-2030 period, while about 6.7% could be mitigated under the moderate afforestation scenario over the same period.

We analyze the impact of climate change on the four key attributes of Indian forests, i.e. impact on vegetation distribution, impact on forest productivity (NPP), impact on soil carbon (SOC) and impact on biomass carbon. IBIS simulations suggest that approximately 39% and 34% of forest grids are projected to experience change in vegetation type under A2 and B2 climate scenarios, respectively over the period 2070-2100. Simulations further indicate that NPP is projected to increase by an average of 66% under the A2 scenario and 49% under the B2 scenario. The increase is higher in the northeastern part of India. However, in the central and western Indian forests NPP remains stable or increases only moderately, and in some places even decreases. Our assessment of the impact of climate change on Soil Organic Carbon (SOC) suggests a trend similar to NPP distribution, which is to be expected as increased NPP is the primary driver of higher litter input to the soil. However, the quantum of increase in this case is lower, around 37% and 30%, for the A2 and B2 scenario respectively (averaged over India). The biomass carbon is also projected to increase all over India on the lines similar to NPP gains. However, projected gains in biomass, NPP and SOC should be viewed with caution as IBIS tends to simulate a fairly strong CO_2 fertilization effect that

may not necessarily be realized under conditions of nutrient and water limitations and under conditions of increased pest and fire outbreaks.

Further we analyzed the impact of climate change on the mitigation potential of Indian forests by linking impact assessment models to mitigation potential assessment model GCOMAP. Two impact assessment models BIOME4 and IBIS are used for simulating the impact of climate change. IBIS is a dynamic vegetation model while BIOME4 is an equilibrium model. Our assessment suggests that with the BIOME4 simulations the cumulative mitigation potential increases by up to 21% under the A2 scenario over the period 2008 to 2108, whereas, under the B2 scenario the mitigation potential increases only by 14% over the same period. However cumulative mitigation potential estimates obtained from the IBIS simulations suggest much smaller gains, where mitigation potential increases by only 6% and 5% over the period 2008 to 2108, under A2 and B2 scenarios respectively.

To enable effective policy analysis and to build a synergy between the mitigation and adaptation efforts in the Indian forest sector, a vulnerability index for the forested grids is constructed. The vulnerability index is based on the premise that forests in India are already subjected to multiple stresses including over extraction, insect outbreaks, live-stock grazing, forest fires and other anthropogenic pressures - with climate change being an additional stress. The forest vulnerability index suggests that nearly 39% of the forest grids in India are projected to be vulnerable to the impacts of climate change under the A2 scenario, while 34% of the forest grids are projected to be vulnerable under the B2 scenario. The vulnerability index suggests that forests in the central part of India, a significant part of the western Himalayan forests and northern and central parts of the Western Ghats are particularly vulnerable to the impacts of climate change. Forests in the northeastern part of India are seemingly resilient to the impacts of climate change. It also suggests that given the high deforestation rate in northeast, this region be prioritized for reducing deforestation and forest degradation (REDD) projects under the United Nations Framework Convention on Climate Change (UNFCCC) mechanisms.